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FOR
Healthy Children

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A SURVEY
OF
EVIDENCE REGARDING

FOOD ALLOWANCES
FOR
HEALTHY CHILDREN

BY

LUCY H. GILLETT

This study and its publication are made possible by
the Department of Social Welfare of the New York
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INTRODUCTION

In computing the food requirements of family groups, it has been customary to regard the man as the unit and assume that the food of each child may be represented by some appropriate fraction of the food of the father. This practice naturally arose from the fact that the food requirements of men had been longer studied and were better known than those of children, few investigations having been made upon children by accurate laboratory methods until within comparatively recent years.

But, as the writer has previously pointed out, the food requirement of a man varies so greatly, according to his occupation, that it seems hardly logical to make this the basis for estimating the dietary needs of a family. Thus a carpenter may require 3500 calories per day; a tailor, 2500; a fourteen year old son of either of these men, 2800 calories. With the carpenter as the unit, the boy's requirement would be represented by 0.8 of that of the father; but with the tailor as the unit, the allowance of 0.8 would obviously provide far too little food for the boy's needs. The Atwater dietary standards for children were stated as decimal fractions of the requirement of a man at moderately active muscular work such as a carpenter requiring 3400 or 3500 calories.

In practice, the dietitian who makes use of these decimal fractions in computing the food requirements of the family, finds it difficult to avoid the tendency to reckon the child's food requirement according to that of the father, which works serious injustice to the child if the father have a low food requirement because of being engaged in an occupation which does not involve active muscular work. Obviously, it is equally inaccurate to assume that the needs of all men are nearly the same, in order that the allowances for the children may approximate uniformity. In our opinion the food requirement of each member of the family should be determined on his own merits rather than in terms of the man's requirement.

A considerable number of direct observations and accurate laboratory experiments upon the total food or energy requirements

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of children of different ages have been recorded during the past thirty years, but the original publications are too widely scattered to be readily available to most students of nutrition. To all such students it will be a source of gratification that the New York Association for Improving the Condition of the Poor, realizing the importance of adequate standards in all family welfare and relief work, has arranged for a systematic survey and digest of all the available data on this subject.

This digest summarizes in convenient form, the net results of modern research upon the energy expenditure or total food requirements of children of all ages and both sexes and permits food allowances for normal children to be estimated upon a more dependable basis than has been possible hitherto. It also brings out the striking paucity of data for certain ages and should serve to stimulate further research in this field.

H. C. SHERMAN.

FOOD ALLOWANCES FOR CHILDREN

The observation of food consumption during certain periods of growth has raised the question as to whether the allowances for the food requirement of children as expressed in terms of the man as a unit are adequate. As this is a vital question in relief work where the physical welfare of the child is to a large extent dependent on its food, the Association for Improving the Condition of the Poor arranged for a survey of the literature, observations, and experiments pertaining to the food requirements of children so that they might be able to make an intelligent allowance for the adequate nourishment of children and at the same time reach as many needy families as possible. While it is apparent that insufficient food may result in serious harm to the children, it is equally clear that an unnecessarily liberal allowance to some families may mean the denial of food to many others where thousands of dollars are used in relief.

Since 1887 numerous observations and experimental studies of the food of children of different ages have been published, but the publications are too widely scattered to be directly available to others than specialists in nutrition research.

The purpose of the present survey has been to review all of the literature pertaining to the subject and to bring together the results which have a direct bearing on the problem of the food requirements of normal children at different ages. All of the literature available in the libraries of Columbia University and of the New York Academy of Medicine has been considered, but only the results of such experiments as were performed on healthy and moderately well-nourished children who, so far as can be judged, were growing normally at the time of observation, have been considered in formulating the food allowances suggested in this report. Table 1, compiled from the work of several observers, was used to determine whether the gain in weight of the subjects included in the averages, was normal.

TABLE 1. TO SHOW DIFFERENCES IN WEIGHT BETWEEN BOYS AND GIRLS — WITH THE INCREASE PER YEAR.*

Age	BOYS		GIRLS	
	Weight	Increase per year	Weight	Increase per year
	lbs.	lbs.	lbs.	lbs.
Birth	7.55		7.16	
6 months	16.00	16.90	15.50	16.68
1 year	20.50	9.00	19.80	8.60
2 years	26.50	6.00	25.50	5.70
3 “	31.20	4.70	30.00	4.50
4 “	35.00	3.80	34.00	4.00
5 yrs. 6 mos.	41.20	4.14	39.80	3.87
6 “ “	45.20	4.00	43.40	3.60
7 “ “	49.50	4.30	47.70	4.30
8 “ “	54.50	5.00	52.50	4.80
9 “ “	59.60	5.10	57.40	4.90
10 “ “	65.40	5.80	62.90	5.50
11 “ “	70.70	5.30	69.50	6.60
12 “ “	76.90	6.20	78.70	9.20
13 “ “	84.80	7.90	88.70	10.00
14 “ “	95.20	10.40	98.30	9.60
15 “ “	107.40	12.20	106.70	8.40
16 “ “	121.00	13.60	112.30	5.60

The food of the child then must be adequate to support this increase in weight in addition to providing energy for both internal and external activity. The amount of energy required for the maintenance of these internal activities (such as respiration, circulation of the blood, and maintenance of a normal "tone" in the muscles) is called basal requirement. These processes which are absolutely necessary for life go on involuntarily even while the subject is lying perfectly quiet, and do not involve any voluntary expenditure of energy.

This basal requirement has been found to be nearly the same for both sexes of the same age and size. Stated per pound or unit of weight, the amount of energy required for the mere processes involved in remaining alive decreases with an increase in age so that a child during the first year of life requires considerably more food per pound than an adult.

In addition to the basal requirement of each individual for the internal activities, the expenditure of energy (and therefore the amount of food required) increases in proportion to the amount of muscular work performed.

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*Table compiled by Mr. Frank A. Manny, A. I. C. P., from observations made by Holt, Burke, and Boas.

Energy expenditure is, therefore, dependent primarily on age, size, and activity, with age as the largest factor. For this reason, in estimating food requirements, we use age as a basis with a range of from 300 to 600 calories to allow for differences in size and activity within each year.

The food allowance is stated in calories because the energy must be the primary consideration, it has been more extensively studied, and is probably better understood than the protein, the mineral salts, or other substances essential for life and growth. While all are known to be essential for life, data concerning the mineral salts and growth-promoting substances are fragmentary, and no attempt has been made to summarize them here. For a long time, however, protein has been connected with growth and such experimental data as are available and might be useful in the establishing of a standard, are included in this report.

The data of the experiments selected as throwing light on normal requirements have been classified according to the age of the child, and the method of research employed in making the original observations. When necessary, the data have been recalculated in order to permit of comparison and averaging on the common basis of energy requirement which is commonly expressed in calories per day.

While the individual cases recorded for the same age and sex often show wide variations, the general trend of the yearly averages is fairly regular, and is believed to afford a much more definite and adequate basis for the estimation of children's food requirements than has been available hitherto. On the basis of the averages thus obtained, food allowances for each year of the normal child's life have been deduced, and are shown in Table 2.

Just as the figures given in Table 2 are based upon data obtained from normal children only, so it is to be emphasized that they are intended to suggest proper food allowances for normal and not necessarily for abnormal children. Thus, greatly emaciated children with depleted tissues which can and ought to be rebuilt rapidly, should receive a more liberal food allowance than would be required by normal children either of the same age or of the same weight.

TABLE 2. FOOD ALLOWANCES FOR CHILDREN*.

AGE YEARS	CALORIES PER DAY	
	BOYS	GIRLS
Under 2	900—1200	900—1200
2- 3	1000—1300	980—1280
3- 4	1100—1400	1060—1360
4- 5	1200—1500	1140—1440
5- 6	1300—1600	1220—1520
6- 7	1400—1700	1300—1600
7- 8	1500—1800	1380—1680
8- 9	1600—1900	1460—1760
9-10	1700—2000	1550—1850
10-11	1900—2200	1650—1950
11-12	2100—2400	1750—2050
12-13	2300—2700	1850—2150
13-14	2500—2900	1950—2250
14-15	2600—3100	2050—2350
15-16	2700—3300	2150—2450
16-17	2700—3400	2250—2550

The limits given above make allowance for individual variation. If a child is tall and growing rapidly at six years of age, he may—and probably will—require 1600 calories. If of smaller frame, an allowance of only 1400 or 1500 calories will be necessary with a normal amount of activity. If he is both large for his age and very active, he will doubtless require the upper limit of the allowance of 1700 calories. It will be seen that this range of calories may be used to provide for the actual needs of each individual child at any age.

In calculating the proper food allowance for a family it is proposed as recommended by Sherman (79) in 1911 that the food requirement (calories per day) of each member of the family be estimated on his own merits, the children as explained above, and the adults in accordance with the principles and data now familiar to students of nutrition through such writings as those of Atwater [2], Lusk [46], and Rose [62, 63]. It may often happen that the food requirement of some other member of the family may exceed that of the man if he be relatively small and inactive.

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*Dr. Henry C. Sherman of Columbia University cooperated in the selection and interpretation of the data, and in formulating the suggested food allowances.

If there is sickness or other special condition which materially affects the dietary habit or nutritive requirement of any member of the family, this as well as age, size, and occupation should also be considered in estimating food allowance, or the money allowance necessary to provide for a suitable food supply.

DETAILED DESCRIPTION OF RESULTS

The evidence with regard to the energy and protein requirement of children has been collected, tabulated, and summarized under three different headings according to the type of data:—

1. Dietary, or observation studies in which the weight of the food eaten by the subjects was recorded for a given period of time, and the food values either determined by analysis or, more commonly calculated from figures representing average composition.

2. Metabolism or balance experiments in which the intake and output were compared by determining chemically the composition of both the food eaten, and the excretory products, thus showing the amount of nitrogen retained in the body for growth of protein tissue.

3. Respiration experiments in which the actual heat produced by the body was either measured directly in an air tight chamber impervious to heat, or calculated from the amount of oxygen consumed and the carbon dioxide exhaled. Since it is known that the oxidation of food yields energy, it follows that a measurement of the oxidation of foodstuffs in the body will give the amount of energy produced. This is usually and most conveniently expressed in calories.

The dietary studies are a measure of the amount of food which a healthy child will eat when allowed a freely chosen diet, and which will, at the same time, maintain a normal weight and provide for normal growth. It gives no measure of utilization or excess—except as increase in body weight may be used as an indication of storage.

The metabolism experiments are more significant of the utilization of food—the increase in body weight signifying adequacy of food, and the amount and kind of material stored in the body serving as an indication of the proper kind of growth. Since increase in weight might be due to the retention of water or a storage of fat out of proportion to muscular tissue, it is important to know that there is a gain of protein as well as a gain in weight.

Respiration experiments are the most accurate measure of the energy expenditure of the body at the exact time of the observation because the oxygen inhaled, and the carbon dioxide exhaled, are in direct proportion to the amount of energy transformed. With this method of measuring energy output, it is possible to determine the amount of food for basal requirement and the influence of muscular work in increasing food requirement.

In young adults when growth is complete and the muscular tonus well developed, it has been found by many observations that the energy requirement per day under conditions of moderate muscular activity is approximately twice the "basal" rate. With very young infants, experiments of a few hours in length have been performed which show that muscular activity may increase the energy output from 30 to 100 per cent above the basal requirement, according to the severity of the exercise. Extreme activity is not continued for the 24 hours of the day so that it is obvious that the energy expenditure of the child for the day will not be doubled by his activity. But the food allowance should provide for growth as well as activity. Hence it has been tentatively assumed here that the basal figure—doubled—will approximately indicate the normal energy requirement of the child.

The following table (3) gives the frequency distribution of the observations and experiments concerning the food requirements of children. The evidence is divided into the three types described above, and is given separately for different periods of growth. It is also divided for the boys and the girls after the first year. There are 223 dietary studies, 131 metabolism experiments, and 209 respiration experiments, making a total of 563 in all. It will be noted that there is a scarcity of data for the second year of life.

TABLE 3. FREQUENCY DISTRIBUTION OF EXPERIMENTS BY AGE, SEX AND EXPERIMENTAL METHOD.

Age	No. of Dietary Studies		No. of Metabolism Experiments		No. of Respiration Experiments		Totals	
1st week	19		6		123		148	
2d, 3d, 4th w'k's	24		4		4		32	
2nd month	25		3		1		29	
3rd "	23		9		5		37	
4-6th "	48		20		25		93	
7-12th "	10*		15		17		42	
	149		57		175			381
	BOYS	GIRLS	BOYS	GIRLS	BOYS	GIRLS		
2nd year	—	—	—	2	—	—	2	
3rd "	2	3	8	4	1	—	18	
4th "	—	3	5	2	—	—	10	
5th "	3	3	6	5	—	—	17	
6th "	1	1	5	—	—	—	7	
7th "	2	4	4	1	2	1	14	
8th "	—	3	2	1	2	1	9	
9th "	3	2	8	1	—	—	14	
10th "	8	3	1	1	1	—	14	
11th "	2	6	2	2	1	—	13	
12th "	2	2	1	1	1	2	9	
13th "	3	2	2	—	4	3	14	
14th "	2	2	3	1	4	1	13	
15th "	3	2	4	—	3	1	13	
16th "	2	1	—	1	—	—	4	
17th "	1	2	—	—	3	—	6	
18th "	1	—	1	—	2	1	5	
	35	39	52	22	24	10		183
Totals	223 *no data beyond the 9th month.		131		209			564

In Table 4 there is summarized an average of the calories and protein furnished by the food where healthy children ate a freely chosen diet. During the first six months, many of the subjects were breast-fed and an average figure was used for determining the caloric value of the milk consumed. Since the figures for these first few months are more suggestive than accurate, it is assumed that they will be used for comparison only. The milk was not analyzed so it was thought best to make no estimate of the amount of protein for these periods. This assumption applies to the first six months only.

TABLE 4. DIETARY STUDY AVERAGES—CALORIES AND PROTEIN FOR EACH MONTH OF THE FIRST YEAR, AND FOR EACH YEAR THROUGH THE 18TH.

AGE	No. of Expts.	Average Weight	INTAKE PER DAY				REFERENCE NUMBERS
			Total		Per kgm.		
			Calories	Protein	Calories	Protein	
		kgms.		gms.		gms.	
1st week	19	3.32	199		60		1, 7(a), 24, 26, 36, 54, 58, 60, 78, 88
2d, 3d, 4th w'k's	24	3.51	376		107		7(a), 23, 24, 26, 36, 54, 58, 60, 70, 78, 88
2nd month	25	4.26	469		110		7(a), 23, 24, 26, 36, 54, 58, 60, 70, 78, 88
3rd "	23	4.91	506		103		7(a), 23, 24, 26, 36, 54, 58, 60, 70, 78, 88
4th "	21	5.61	539		96		7(a), 23, 24, 26, 36, 54, 58, 60, 64, 78, 88
5th "	16	6.11	556		91		7(a), 23, 24, 26, 36, 54, 60, 64, 78, 88
6th "	11	7.20	619		86		7(a), 23, 24, 26, 36, 60, 88
7th "	6	7.37	619		84		7(a), 23, 88
8th "	2	7.54	686		91		23
9th "	2	8.17	703		86		23
10th "	....	....	....		....		
11th "	....	....	....		....		
12th "	....	....	....		....		
2nd year	....	....	....		....		
3rd "	5	13.4	1139	49	85	3.66	29, 32, 81
4th "	3	15.7	1116	48	71	3.06	29, 81
5th "	6	16.9	1363	56	81	3.31	29, 31, 32, 81
6th "	2	17.1	1385	57	81	3.33	29, 81
7th "	6	18.9	1536	61	81	3.23	41, 81
8th "	3	22.8	1487	62	65	2.72	41, 81
9th "	5	24.5	1922	64	78	2.61	29, 41, 61, 81
10th "	11	27.7	1880	74	68	2.67	29, 32, 41, 66, 81
11th "	8	30.3	1822	62	60	2.04	12, 29, 32, 41, 81
12th "	4	34.3	2342	99	68	2.89	81
13th "	5	40.5	2122	78	52	1.92	29, 32, 61, 81
14th "	4	34.3	2234	65	65	1.89	41, 66, 81
15th "	5	38.0	1927	77	51	2.03	12, 32, 81
16th "	3	44.0	3084	105	70	2.39	81
17th "	3	51.0	2104	92	41	1.80	81
18th "	1	67.0	4032	154	60	2.30	81

Both calories and protein have been reduced to the per kilogram basis so that variations in weight may not have to be considered in the comparison. It is here clearly shown that the number of calories and the amount of protein per unit of weight decreases gradually from infancy to adult life while the total amounts increase.

In Table 5, the averages for the calories and protein from the metabolism experiments are expressed per man per day and per unit of weights as in Table 4. It will be noted that both calories and protein per kilogram for both dietary studies and metabolism experiments agree fairly well, although the total amounts are somewhat varied. The calories decrease from about 100 per kilogram during the first few months of infancy to about 60 during the 17th and 18th years, while the protein decreases in about the same proportion. The amount of nitrogen in the food eaten is also given for comparison with the amount of nitrogen stored. Since the amount of nitrogen stored is presumably a measure of the growth of protein tissue, indicating to a certain extent the adequacy of the food, only such experiments have been included in the average as showed a storage of nitrogen by the body.

Similarly in Table 6, the averages from the respiration experiments have been arranged. It will be recalled that these figures represent basal requirement and as such cannot be directly compared with the figures in the two preceding tables. But the same decrease per unit of weight from infancy on through the period of growth is noted here as was observed previously. For the reasons explained above (page 11) this basal figure has been doubled as a basis for estimating the normal allowance for the child. In this table only such experiments as give basal requirement are tabulated. Other experiments in which the results have been influenced by varying amounts of activity have been used for comparison and verification, in deducting the allowance but are not recorded here. For this reason there may seem to be a discrepancy in the number of experiments as compared with Table 3.

TABLE 5. METABOLISM EXPERIMENT AVERAGES. TOTAL INTAKE OF CALORIES AND PROTEIN PER MAN; ALSO PER KILOGRAM. PROTEIN ALSO EXPRESSED AS NITROGEN.

AGE	No. of Expts.	Average Weight	INTAKE PER DAY				Nitrogen		REFERENCE NUMBERS
			Total		Per kgm.				
			Calories	Protein	Calories	Protein	Intake	Stored	
		kgms.		gms.		gms.	gms.	gms.	
1st week	6	3.33	......	12.94	......	3.89	2.07	1.02	9, 42, 44
2d, 3d, 4th w'k's	4	3.36	......	15.44	......	4.60	2.47	1.44	42, 43, 44
2nd month	3	......	......	14.18	......	*4.46	2.27	0.87	28, 43
3rd “	9	3.85	......	16.56	......	4.30	2.65	0.96	42, 43, 50, 56, 57, 67, 85
4th “	9	4.51	523	17.25	116	3.83	2.76	0.78	5, 11, 28, 52, 83, 85
5th “	9	4.66	522	16.44	112	3.53	2.63	0.75	20, 21, 28, 43, 83
6th “	2	5.71	468	18.37	82	3.22	2.94	0.66	20, 57
7th “	6	7.69	761	30.87	99	4.01	4.94	1.10	21, 75
8th “	1	7.57	681	26.62	90	3.51	4.26	0.73	68
9th “	4	6.02	614	30.25	102	5.02	4.84	0.65	22, 87
10th “	....	......	......	......	......	......	......	......	
11th “	4	7.21	735	25.12	102	3.48	4.02	0.84	8, 20
12th “	....	......	......	......	......	......	......	......	
2nd year	2	*9.7	*960	39.19	*99	*4.86	6.27	0.77	13, 18
3rd “	12	12.6	1152	42.25	91	3.35	6.76	1.49	4, 49, 86
4th “	7	12.7	1294	44.31	102	3.50	7.09	0.81	13, 49
5th “	11	14.7	1408	44.00	96	3.00	7.04	1.19	49, 80, 81
6th “	5	17.1	1617	55.88	95	3.27	8.94	0.75	13, 49, 80
7th “	5	16.0	1578	54.31	99	3.40	8.69	0.53	33, 49
8th “	3	17.5	1555	49.00	89	2.80	7.84	1.48	33, 41, 80
9th “	9	21.7	1612	41.31	74	1.90	6.61	0.91	13, 33, 80
10th “	2	22.2	1324	42.56	60	1.92	6.81	0.52	17, 80
11th “	4	23.1	1683	50.81	73	2.19	8.13	1.69	19, 80, 81
12th “	2	21.6	1561	64.31	72	2.98	10.29	1.19	17, 33
13th “	2	33.0	1685	45.00	51	1.37	7.20	1.97	80
14th “	4	41.2	2260	71.00	55	1.72	11.36	1.31	18, 33, 34, 80
15th “	4	33.8	2174	83.81	64	2.50	13.41	2.73	33, 34, 40
16th “	1	39.3	1743	62.12	45	1.58	9.94	0.83	18
17th “	....	......	......	......	......	......	......	......	
18th “	1	38.2	2360	100.00	62	2.62	16.00	0.52	18
		* 1 case only			* 1 case only				

TABLE 6. RESPIRATION EXPERIMENT AVERAGES. BASAL ENERGY EXPENDITURE PER MAN PER DAY, AND PER KILOGRAM.

AGE	No. of Expts.	Average Weight	Basal Energy Expenditure		REFERENCE NUMBERS
			Total	Per kgm.	
		kgms.	Calories	Calories	
1st week	112	3.40	146	43	3, 7, 30
2d, 3d, 4th w'k's	4	4.10	217	53	3, 6
2nd month	1	2.99	164	55	6
3rd "	3	5.18	300	58	*6, 37, 51, 67, 74
4th "	5	5.47	323	59	6, 39, 51, 71, 74
5th "	6	5.38	317	59	6, 39, 71, 74
6th "	2	7.37	376	51	*6, 68, 71, 73, 75
7th "	4	6.09	378	62	*6, 71, 73, 75, 76
8th "	3	6.80	442	65	6, 68
9th "	2	5.82	471	81	6, 39
10th "	1	8.45	423	50	72
11th "	....	....	....	....	*6, 51
12th "	3	8.34	509	61	6, 51, 72
2nd year	....	....	....	....	
3rd "	1	11.50	784	68	48
4th "	....	....	....	....	
5th "	....	....	....	....	
6th "	....	....	....	....	
7th "	3	17.0	943	56	48
8th "	3	18.4	1030	56	48
9th "	....	....	....	....	
10th "	1	21.8	1046	48	48
11th "	1	30.6	1346	44	48
12th "	3	34.5	1302	38	48
13th "	7	31.6	1261	40	25, 48
14th "	5	32.5	1339	41	25, 48
15th "	4	37.8	1362	36	48
16th "	....	....	....	....	
17th "	3	51.4	1541	30	48
18th "	3	46.1	1418	31	48

*Including references used for comparison in addition to basal

In view of the limited number of experiments by any one method in any one year (except the first) the three types of data have been averaged in groups corresponding to those commonly used in calculating dietary studies of families. The average number of calories and the amount of protein per man per day for each of the three types of data is given separately (Table 7), with a weighted average of the calories from the three. (The basal requirement from the respiration experiment has been doubled to make it comparable with the dietary and metabolism experiments).

The first two years have not been included for three reasons. First, there are only two experiments for the second year against 381 for the first year which would make the resulting figure

Table 7. Average calories and protein per day from dietary, metabolism, and respiration experiments (averaged in usual age groups).

Age group.	EXPERIMENT		Average Weight kgms.	TOTAL CALORIES PER DAY				Weighted Average Calories	PROTEIN PER DAY	
						Respiration Expts.				
	Kind	No. of		Dietary Studies	Metabolism Expts.	Basal	Basal-doubled		Dietary	Metabolism
									gms.	gms.
2-5 years (inclusive)	Dietary	16	15.6	1250						
	Metabolism	35	13.9		1327			1308	53	45
	Respiration	1	11.5			(784)	1568			
6-9 years (inclusive)	Dietary	25	24.3	1758						
	Metabolism	19	19.6		1564					
	Respiration	7	18:3			(995)	1990	1718	67	46
10-13 years (inclusive)	Dietary	21	34.2	2071						
	Metabolism	12	30.5		1855					
	Respiration	16	32.4			(1299)	2598	2190	73	59
14-17 years (inclusive)	Dietary	12	45.1	2436						
	Metabolism	6	35.4		2133					
	Respiration	10	44.4			(1433)	2866	2525	94	83

misleading if the two years were averaged together and two experiments could hardly establish a standard for the second year; second, because of the rapid changes in the food requirement for this period, it is not felt that an average, extending over a period during which the food requirement doubles, is very significant; and third, since, during the first few months of the child's life, the natural method of feeding is through the mother, the food requirement of the mother is increased considerably more than the requirement of the child so that it can hardly be stated in terms of the child. (Probably the mother requires at least two calories of extra food for each calorie of milk which she produces. Rose, "Feeding the Family.")

The averages given in Table 7 make no distinction in the requirements of boys and girls. Referring to Table 1, in which the weights for both are given, we find the average weight of the boys to be more than that of the girls. It is also generally accepted that boys are more active than girls, especially after the ninth or tenth year. With these facts in mind, the accompanying Table (8) has been arranged. In general, the number of calories for the boys runs higher than for the girls.

TABLE 8. AVERAGE NUMBER OF CALORIES OF BOYS AND GIRLS FOR EACH YEAR.

AGE	BOYS		GIRLS	
	No. of Expts.	Calories	No. of Expts.	Calories
2- 3 years....	8	1203	6	1126
3- 4 "	5	1377	5	1097
4- 5 "	9	1369	8	1419
5- 6 "	6	1583	1	1356
6- 7 "	8	1698	6	1529
7- 8 "	5	1924	5	1510
8- 9 "	11	1736	3	1673
9-10 "	10	1883	4	1649
10-11 "	5	1832	8	1855
11-12 "	4	2451	4	1889
12-13 "	8	2423	6	2267
13-14 "	9	2562	3	2358
14-15 "	10	2296	3	2089
15-16 "	2	2795	2	2703
16-17 "	4	2983	2	1815
17-18 "	4	3051	....	....

Comparing the calories for boys with those for girls in groups

TABLE 9. COMPARISON BETWEEN CALORIES USED BY BOYS AND GIRLS FROM EACH TYPE OF EXPERIMENT, WITH AN AVERAGE OF THE THREE FOR BOTH BOYS AND GIRLS.

Kind of experiment	No. of Expts.	Average weight	Calories from			calories Average
			Dietary Studies	Metabolism Expts.	Respiration Expts.	
		kgms.				
BOYS						
2-5 years (inclusive)			1298	1301	1568	1309 (13.8 kgms.)
Dietary	6	15.3				
Metabolism	25	13.5				
Respiration	1	11.5				
6-9 years (inclusive)			1889	1627	2064	1797 (22.3 kgms.)
Dietary	13	26.2				
Metabolism	15	20.1				
Respiration	5	18.9				
10-13 yrs (inclusive)			2280	1918	2724	2337 (32.2 kgms.)
Dietary	9	33.3				
Metabolism	8	31.5				
Respiration	10	32.1				
14-17 yrs (inclusive)			2615	2211	2664	2534 (41.2 kgms.)
Dietary	7	42.0				
Metabolism	5	34.5				
Respiration	8	44.8				
GIRLS						
2-5 years (inclusive)			1222	1267	....	1245 (14.6 kgms.)
Dietary	10	15.8				
Metabolism	11	13.5				
Respiration	....	......				
6-9 years (inclusive)			1618	1328	1808	1575 (20.7 kgms.)
Dietary	12	22.4				
Metabolism	4	17.8				
Respiration	2	16.7				
10-13 yrs (inclusive)			1914	1730	2406	2015 (33.2 kgms.)
Dietary	12	34.9				
Metabolism	4	28.7				
Respiration	6	33.0				
14-17 yrs (inclusive)			2190	1743	2664	2253 (46.8 kgms.)
Dietary	5	49.0				
Metabolism	1	39.3				
Respiration	2	44.8				

large enough to minimize chance variations, we find the total calories increasing for the boys somewhat more rapidly than for the girls, the difference after the fifth year becoming more marked as the difference in weight becomes greater. Not only do the averages of the three types of experiments show a larger number of calories for the boys but each separate type of experiment emphasizes the same point. In spite of the fact that in general the average weight of the girls in these particular cases was more than the average weight of the boys, the total number of calories for the boys is more than for the girls.

The relationship between the calories used by the boys and by the girls is more clearly brought out in the following summary table where the requirement for the boys seems to be slightly higher than the average for both boys and girls while that for the girls is decidedly lower.

TABLE 10. TO SHOW THE DIFFERENCE IN TOTAL CALORIES BETWEEN BOYS AND GIRLS AT DIFFERENT AGES.

	2-5 years	6-9 years	10-13 years	14-17 years
	Calories	Calories	Calories	Calories
Boys and Girls	1308	1718	2190	2525
Boys	1309	1797	2337	2534
Girls	1245	1575	2015	2253

The question now arises as to how much of this difference might be attributed to a difference in weight. To eliminate any error from such a cause, the above figures have been reduced to the basis of the number of calories required per day per pound of body weight, with the result as shown in Table 11.

TABLE 11. TO SHOW THE DIFFERENCE IN CALORIES PER POUND FOR BOYS AND GIRLS AT VARIOUS AGES.

	2-5 years	6-9 years	10-13 years	14-17 years
	Calories	Calories	Calories	Calories
Boys and Girls	41.4	35.9	30.5	26.8
Boys	43.2	36.9	32.8	28.2
Girls	38.7	34.6	27.8	21.9

For ease of comparison, the differences in calories per capita and per unit of weight are expressed in percentage in Table 12.

TABLE 12. REQUIREMENT OF BOYS OVER GIRLS EXPRESSED IN PERCENTAGE FOR BOTH THE PER CAPITA AND PER POUND BASIS.

Age	Per Capita	Per Pound
2- 5 years	5 per cent	12 per cent
6- 9 "	14 " "	7 " "
10-13 "	16 " "	18 " "
14-17 "	13 " "	29 " "

In the above Table (12) the percentage of difference between the calories per pound for boys and girls from 2 to 5 years, inclusive, is probably accidental and misleading. If each type of data instead of the average of the three is reduced to the unit of weight basis (Table 13), it will be noted that the average for girls during this period are not consistently low, and furthermore, there are no respiration experiments for girls. As the age increases, the difference between the two becomes greater. In two periods, the figures from the respiration experiments are the same for both boys and girls. This is in agreement with Magnus-Levy who says that both sexes have the same basal requirement. In our allowance for activity in these experiments, we have doubled the basal for both boys and girls which explains the similarity in agreement, and may be somewhat generous for the girls.

TABLE 13. TO SHOW THE CALORIES PER POUND FOR BOYS AND GIRLS FROM EACH OF THREE TYPES OF DATA.

AGE GROUP	BOYS			GIRLS		
	Calories per pound			Calories per pound		
Years	Dietary Expts.	Metabolism Expts.	Respiration Expts.	Dietary Expts.	Metabolism Expts.	Respiration Expts.
2- 5	38.7	44.1	61.9	35.0	42.8	......
6- 9	32.8	36.9	49.6	32.8	34.1	49.6
10-13	30.9	27.8	38.7	25.0	27.3	33.2
14-17	28.2	29.1	26.9	20.5	20.0	26.9

It does not seem justifiable to discriminate more closely between the food requirements of boys and girls without further research work planned for this purpose. Convincing evidence could be obtained only from data representing the same method of observation or experiment for both sexes of the same age and of approximately the average height and weight for the age and sex.

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